National Aeronautics and Space Administration

Christopher Stock
ESMD Headquarters – EVM Lead

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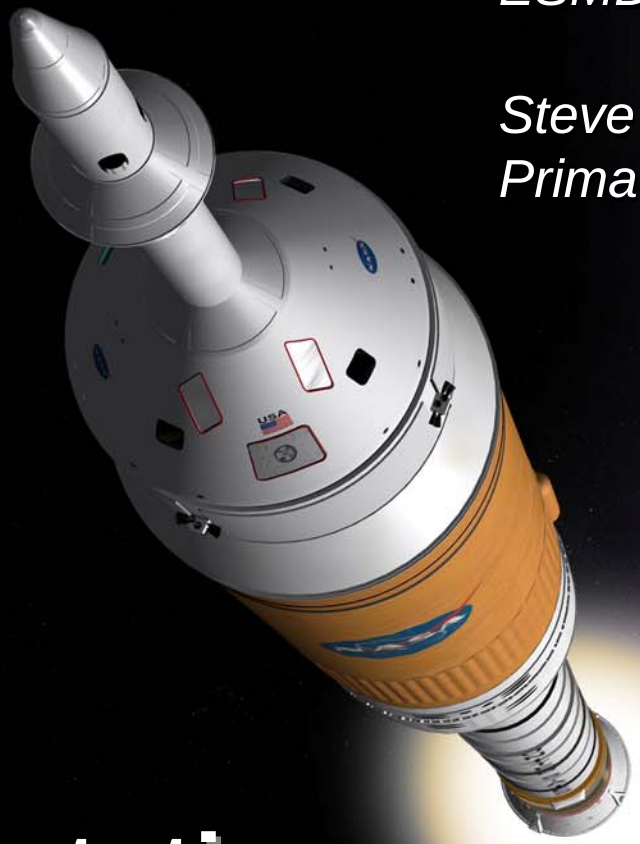
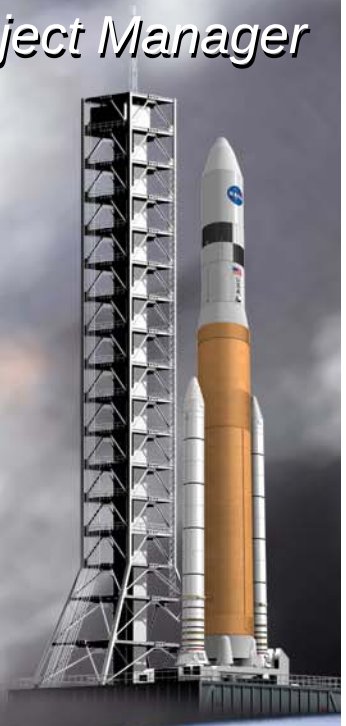
Primavera Systems - Project Manager





ESMD EVM Implementation

Large Program Coordination among multiple dispersed teams

Exploration Roadmap

05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

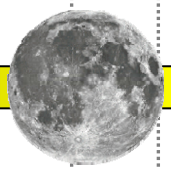
Initial CEV Capability

1st Human CEV Flight

Lunar Outpost Buildup

7th Human Lunar Landing

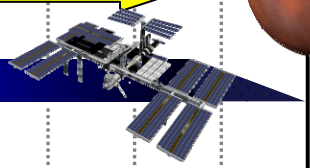
Lunar Robotic Missions



Science Robotic Missions

Mars Expedition Design

Commercial Crew/Cargo for ISS

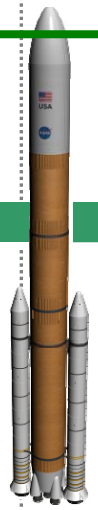


Space Shuttle Ops

CEV Development

Crew Launch Development

CEV Production and Operations



Early Design Activity

Lunar Lander Development

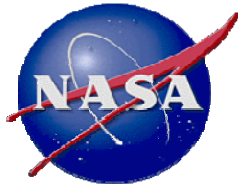
Lunar Heavy Launch Development

Earth Departure Stage Development

Surface Systems Development

Note: Specific dates and milestones not yet established. CEV/CLV availability planned for as close to 2010 as possible, but NLT 2014. Return to the moon as early as 2018 , but NLT 2020.

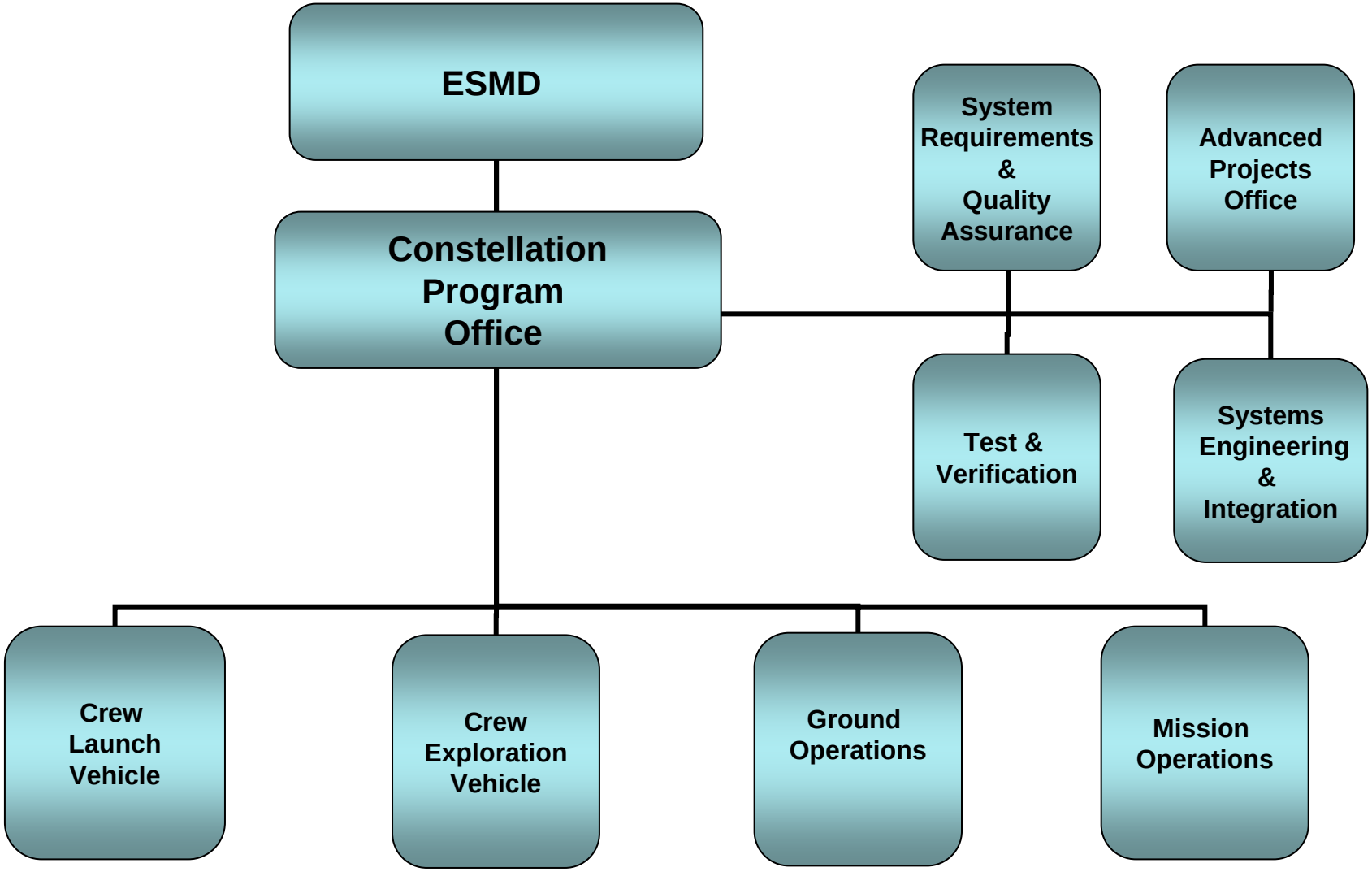
Current Target Groups



- **Constellation Program Office (JSC)**
- **Constellation Level II Offices (JSC)**
  - T&V – Testing and Verification
  - SE&I – Systems Engineering and Integration
  - SR&QA – System Requirements and Quality Assurance
  - APO – Advanced Projects Office
- **Crew Exploration Vehicle (JSC)**
- **Crew Launch Vehicle (MSFC)**
- **MO - Mission Operations (JSC)**
- **GO - Ground Operations (KSC)**

JSC – Houston, TX
MSFC – Huntsville, AL
KSC – Cape Canaveral, FL
LaRC – Hampton, VA
GRC – Cleveland, OH
DFRC – Edwards, CA

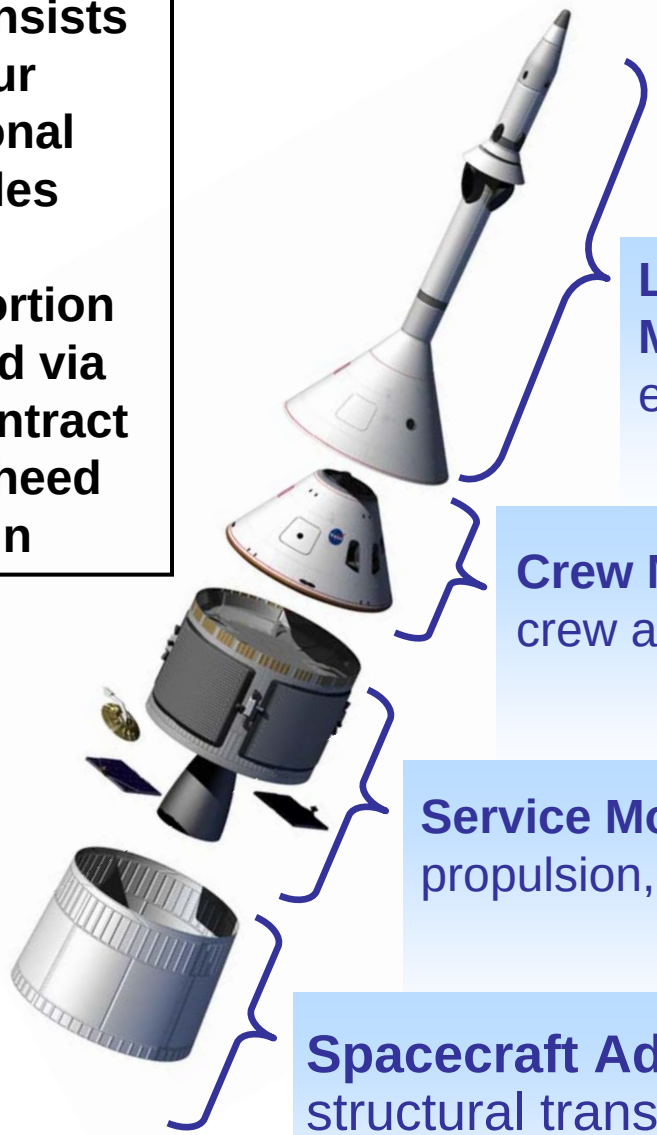
ESMD EVM Implementation Organizational Structure



Project Orion

Orion consists of four functional modules

Large portion managed via Prime contract to Lockheed Martin



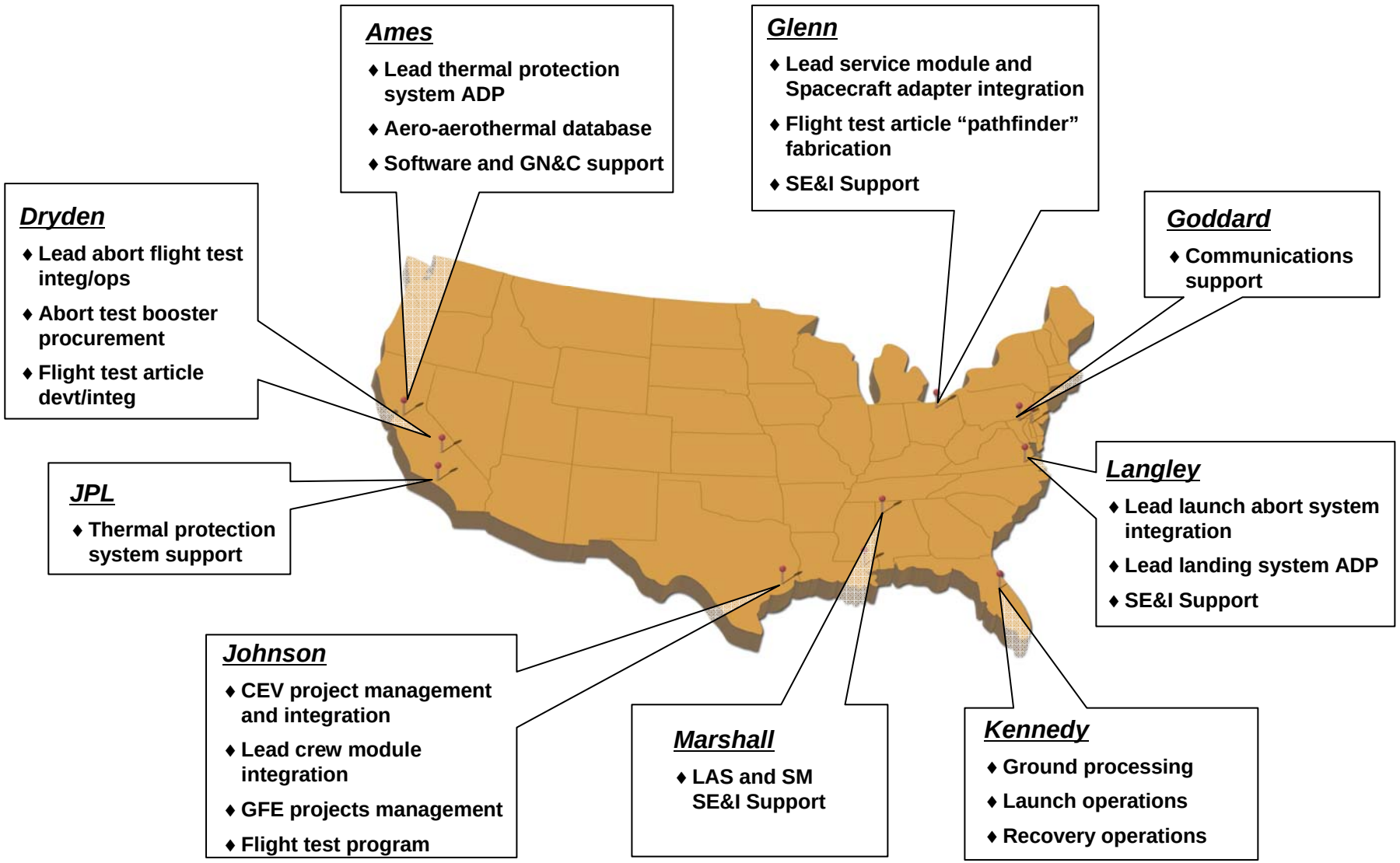
Launch Abort System (LaRC & MSFC) --
emergency escape during launch

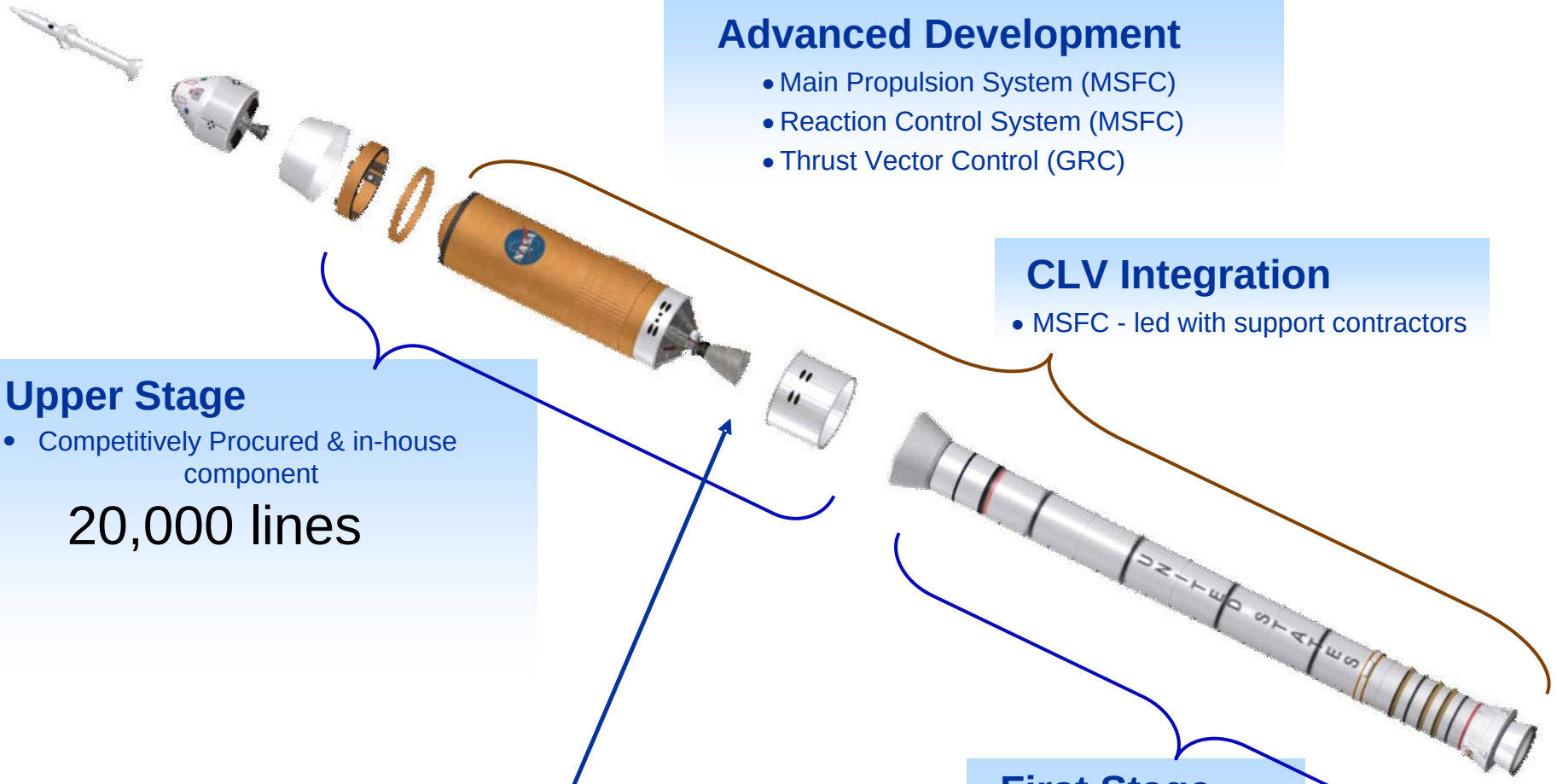
Crew Module (JSC) –
crew and cargo transport

Service Module (GRC) –
propulsion, electrical power, fluids storage

Spacecraft Adapter (GRC) –
structural transition to launch vehicle

Orion Leveraging Unique Skills Throughout NASA





Advanced Development

- Main Propulsion System (MSFC)
- Reaction Control System (MSFC)
- Thrust Vector Control (GRC)

CLV Integration

- MSFC - led with support contractors

Upper Stage

- Competitively Procured & in-house component

20,000 lines

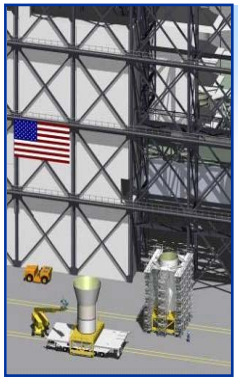
Upper Stage Engine (J-2X)

- Sole Source to PWR

First Stage

Sole Source to ATK

Ground Operations Project (KSC)



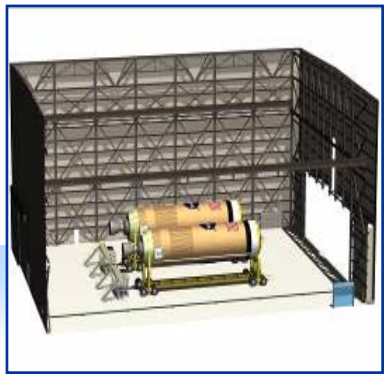
Ares 1-I

- Contract support
- Mods to PADs

Infrastructure Mods

Ground Support Equipment

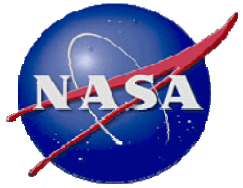
Spacecraft Standalone Processing



Launch Vehicle Standalone Processing

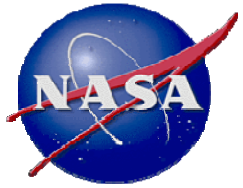
Integrated Operations & Launch Processing

ARES-1 Team Structure (Pilot)



- **First Stage – ATK, part of Ares I Contact.**
  - 4-Seg SRB from Shuttle Inventory
- **Upper Stage Simulator – To be Built in-house at GRC**
  - Largest in-house scope and Great Opportunity for EVM
- **CM/LAS – To be Built in-house at LaRC**
- **Vehicle Integration – At LaRC**
- **Avionics – Prime contract to Lockheed Martin, with some in-house**
- **Roll Control – Contract with Teledyne-Brown, in-house, and parts to be salvaged from Peacekeepers at White Sands**
- **Ground Operations – KSC, not part of MSFC managed scope.**
  - Working closely to integrate schedules

Seven EVMS Principles



1. Plan **all work scope for the project to completion.**

2. Break Down **the project work scope into finite pieces that can be assigned to a responsible person or organization for control of technical, schedule, and cost objectives.**

3. Integrate **project work scope, schedule, and cost objectives into a Performance Measurement Baseline (PMB) plan against which accomplishments can be measured and control changes to the baseline.**

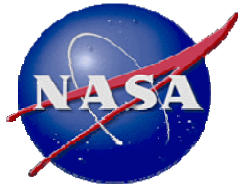
4. Use Actual Costs **incurred and recorded in accomplishing the work performed.**

5. Objectively assess accomplishments **at the work-performed level.**

6. Analyze significant variances **from the plan, forecast impacts, and prepare an Estimate at Completion (EAC) based on performance to date and work to be performed.**

7. Use EVM information **in Corporation's management processes.**

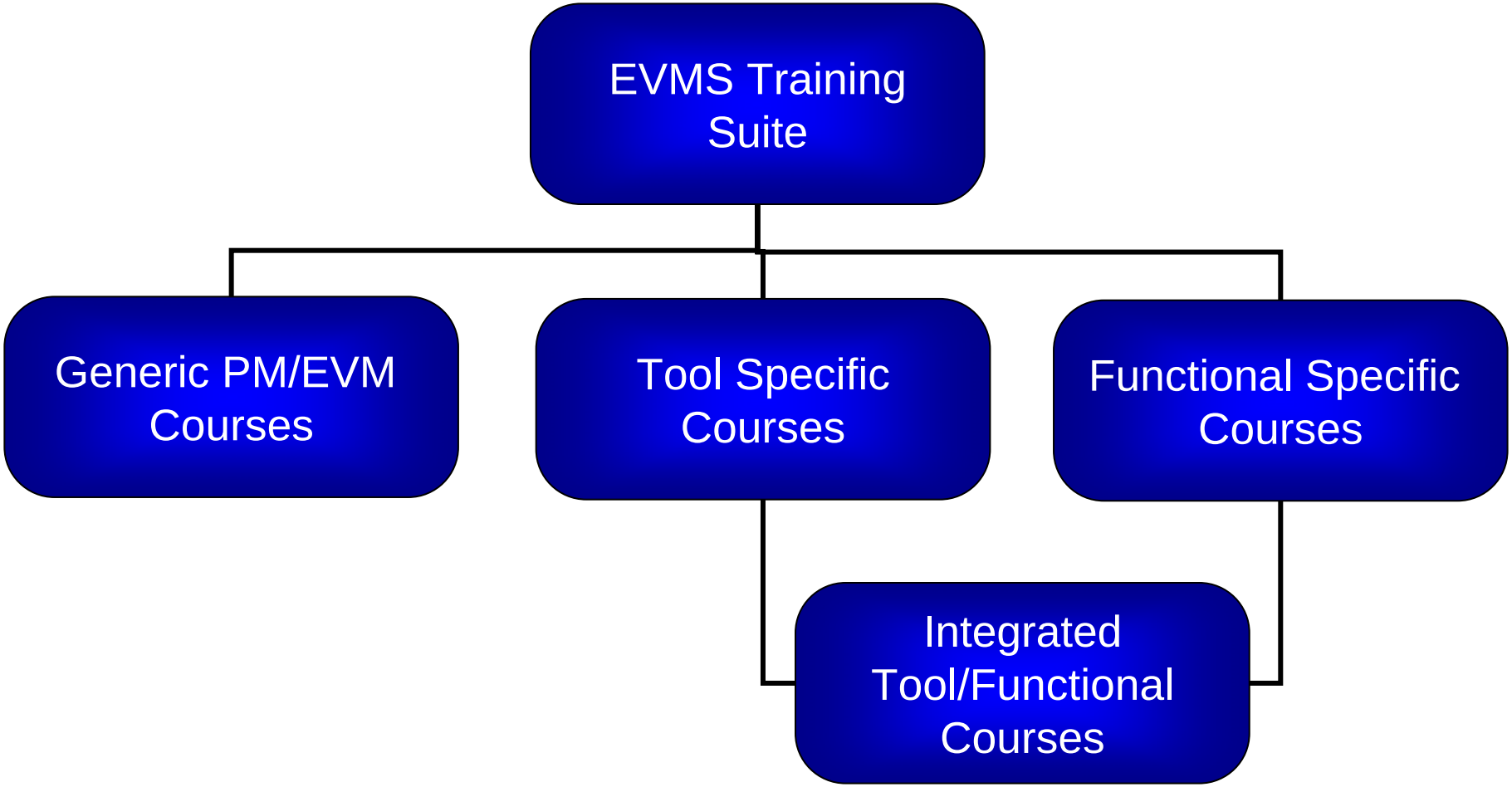
Five Process Development Areas



- **Five Process Development Areas within ANSI 748A:**
  1. Organizing
  2. Planning, Scheduling, and Budgeting
  3. Accounting Considerations
  4. Analysis and Management Reporting
  5. Revisions and Data Maintenance

- **Constellation Program Determined the process "Roadmap"**
- **Teams were responsible and accountable to provide the details of how each roadmap element was addressed (with guidance)**

EVMS Training Suite

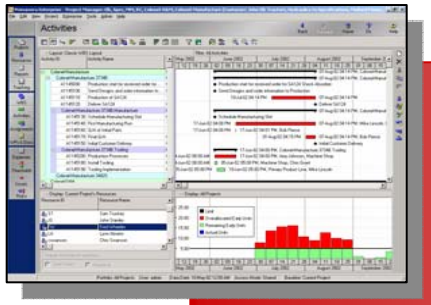


Integrated Management Tool

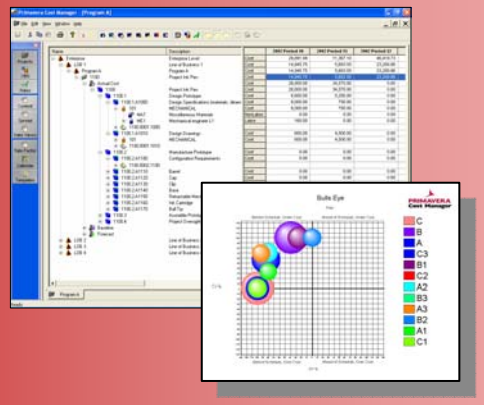
(EV key inputs are BCWS, BCWP, ACWP, & ETC)

Project Manager

BCWS, BCWP, ETC

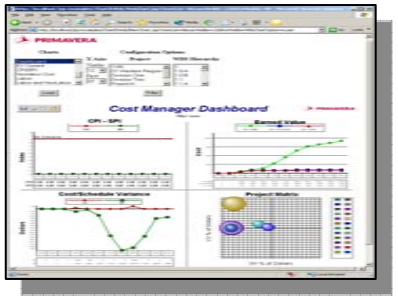


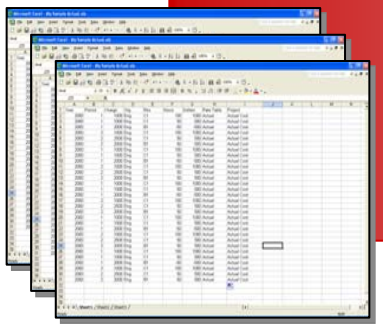
Cost Manager



MyPrimavera

Graphical Output (wInsight or Cost Manager)

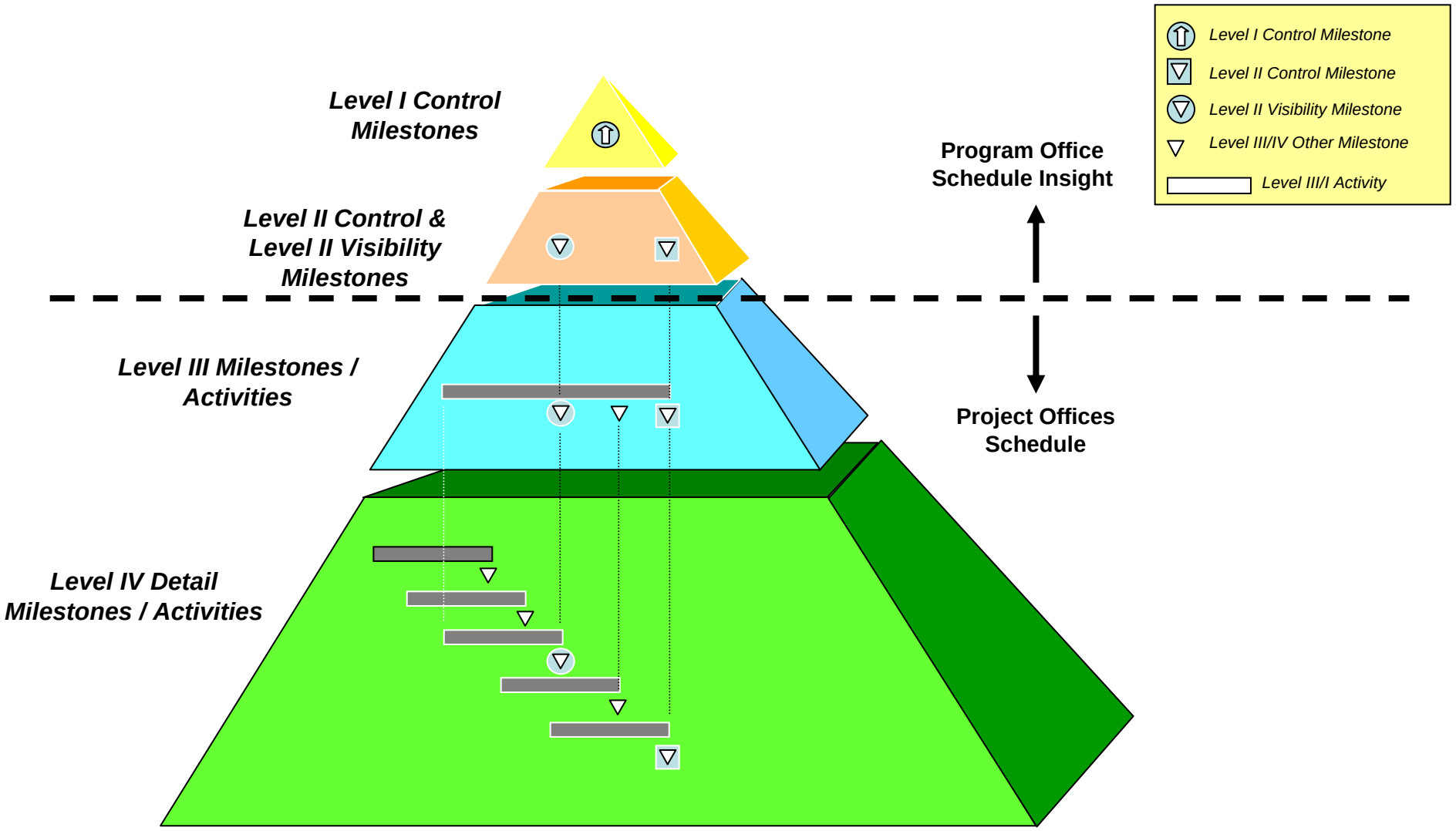




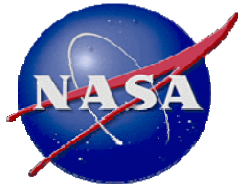
SAP Accounting System

ACWP

Constellation Milestone Management



Scheduling Initiative Supporting EVM



- **Network based (predecessor/successor logic)**
- **Vertical integration to Major/Key Milestones (Level I, II, III)**
- **Integrated schedules (prime contractors, civil servants, support contractors)**
- **Resource Loaded**
- **Control Accounts**
  - Work Packages
  - Planning Packages
- **Schedule Status & Analysis**
- **Change Control (EVM and Control Milestones)**

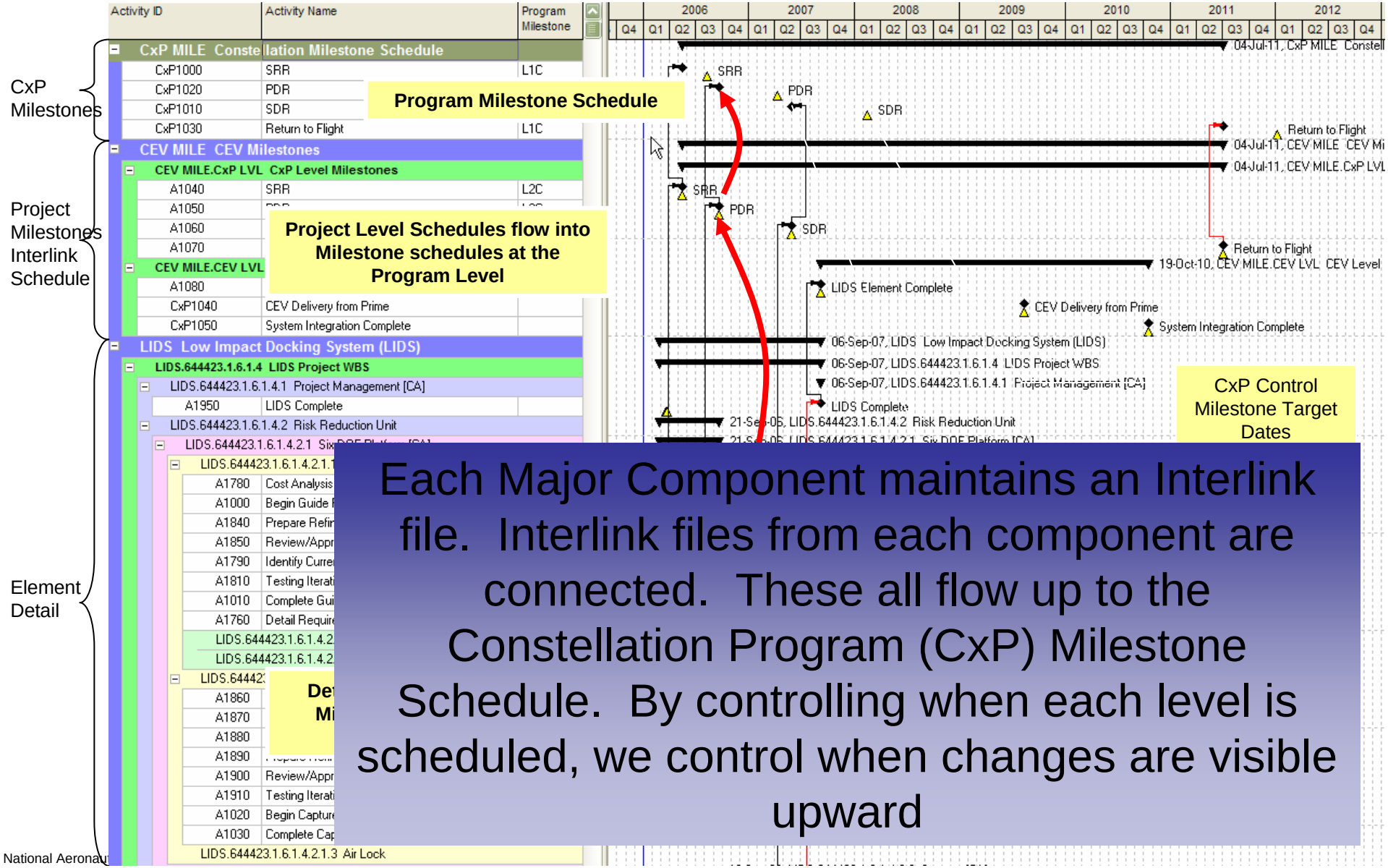
Lessons Learned

Contractor Interface

Contract Import Philosophy – At a minimum … 1 Activity per WBS line of their Cost Performance Report (CPR) ~then~ enough detail lower than that to demonstrate clear paths. Emphasis is on interface milestones.

- **Resource Loading is at the same level as CPR or 533**
- **Some Contractors have volunteered more**
  - Their schedules are pure imports from MS Project to PM (monthly)
  - Status at Summary Levels will be consistent with CPR
  - WBS syncs neatly
- **Negotiating the right detail with others**
  - They can still provide the entire detailed schedule
  - Scheduler supporting NASA to convert and do analysis.

IMS Horizontal / Vertical Integration



WBS

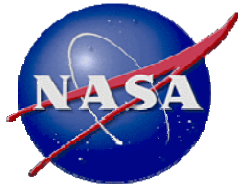
Many Teams share a WBS or portions of it for a given Project/Scope

- **Financial WBS = Technical WBS = Charge Code Set-up**
  - Requires more frequent meetings and involvement of all team members across the project and space centers
  - This technical limitation also proved to be a catalyst for communication

WBS Composed of …

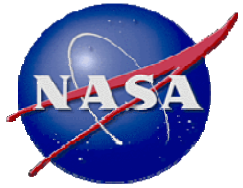
- ***Project***
  - *Control Account* – CAP, Cost & Schedule Performance Measurement
    - *Work Packages* (Charge Code Level) – Adequate measurement size, some accounting and NASA policy restrictions, can do schedule performance measurement
      - *Activities* – Resource Loading & basic Earned Value entry level

Project/Center Collaboration



- **Current disbursement of project management responsibilities require:**
  - Communicate the need for consistent Agency wide Center management approach built around earned value management
  - Develop short term and long term approach for sustainment of EVM
  - Obtain Center buy-in on EVM strategies
  - Strong Center leadership support
  - Inter/Intra-Center cooperation
- **Provide necessary support:**
  - Processes and tools to aid in implementation
  - Education for all project team members
  - Not just mandate, but actively participate in implementation

Major Takeaways



- **Need for Super-users at each project & Center**
  - New Tool - lots of hand holding
  - EVM requires them to do more then previous scheduling needs
- **Center centric approach to managing projects**
  - Moving to an Programmatic integrated approach
  - Consolidation of best practices among Centers
- **Need Strong Institutional Functional Support**
- **Need Strong Buy-in at all levels (Executive, Program, Project, Sub-project, Center)**
- **Already Working Cultural Issue – *EVM-aphobia***
  - Misunderstanding of what comprises EVM
  - EVM is implemented by a project team not the project manager, EVM guy or scheduler